SUBCOMMITTEE ON SPACE AND AERONAUTICS
COMMITTEE ON SCIENCE
U.S. HOUSE OF REPRESENTATIVES

HEARING CHARTER

The Future of Aeronautics at NASA

March 16, 2005
10:00 a.m. to 12:00 p.m.
2318 Rayburn House Office Building

Purpose

On Wednesday, March 16, at 10:00 a.m., the Subcommittee on Space and Aeronautics will hold a hearing on the proposed Fiscal Year (FY) 2006 budget for aeronautics at the National Aeronautics and Space Administration's (NASA).

The budget proposes significant changes in NASA's aeronautic programs, including, over the next five years, dramatic cuts in funding and staffing, closure of facilities, and redirection of research priorities. NASA argues that these proposed changes would enable NASA to focus on the highest priority areas in aeronautics while freeing up agency funds for space exploration programs, the agency's highest priority.

NASA has played a role in advancing aeronautics since its inception. Indeed, NASA was created by expanding the National Advisory Committee on Aeronautics (NACA), a federal agency created in 1917 to promote aeronautics. NASA's Langley Research Center in Virginia, one of its aeronautics centers, dates back to 1917.

Today, aeronautics programs are run by NASA's Aeronautics Research Mission Directorate (ARMD). No other federal agency supports research on civilian aircraft. NASA's aeronautics program also conducts most of the research on air traffic control systems, a responsibility it shares with the Federal Aviation Administration (FAA). The Aeronautics Directorate includes three NASA Centers: Glenn Research Center, Ohio; Dryden Research Center, California; and Langley Research Center, Virginia.

Overarching Questions

The Committee plans to explore the following overarching questions at the hearing:

1. What are the trends in civil aeronautics and what should the U.S. national strategy be for civil aeronautics research and development?

2. What is NASA's aeronautics research strategy and how well does it align with the nation's strategic needs for civil aeronautics research?

3. Should NASA preserve its inventory of wind tunnels and propulsion test facilities until a new national strategy can be developed and funded?

4. How does NASA intend to achieve the workforce reductions it has proposed without losing essential skills and capabilities?

Witnesses

Dr. Vic Lebacqz is Associate Administrator of the Aeronautics Research Mission Directorate, National Aeronautics and Space Administration. He was named to his current position since January 2004, after serving about six months in an acting capacity.

Dr. John Klineberg led a 2004 National Academy of Sciences study entitled "Review of NASA's Aerospace Technology Enterprise: An Assessment of NASA's Aeronautics Technology Program." He is retired as president of Space Systems/Loral, and for 25 years worked at NASA, including as director of the Goddard Space Flight Research Center and the Ames Research Center.

Dr. Philip Anton was the principal investigator of a 2004 report produced by the RAND Corporation entitled "Wind Tunnels and Propulsion Test Facilities: An Assessment of NASA's Capabilities to Serve National Needs." The report was jointly sponsored by NASA and the Department of Defense. He is a senior scientist at RAND, which is a Federally Funded Research and Development Center sponsored by the Department of Defense.

Dr. Mike Benzakein was named chairman of the Department of Aerospace Engineering at the Ohio State University in October 2004. From 1967 through 2004 he worked for GE Aircraft Engines and retired as General Manager of Advanced Technology and Military Engineering.

Dr. John Hansman is a professor of Aeronautics and Astronautics at the Massachusetts Institute of Technology, and Director of the International Center for Air Transportation.

FY06 Aeronautics Budget Highlights

Over the last decade, funding for NASA's aeronautics research has declined by more than half, to about $900 million. For FY06, NASA proposes a relatively small decrease ($54 million, or about 6 percent) in aeronautics research and development compared to its FY05 Operating Plan. But the agency's proposed five-year runout for aeronautics contemplates substantial funding reductions (20 percent) for aeronautics research, together with significant cutbacks in its civil service and contractor workforces.

Civil service personnel and infrastructure costs account for much of the Aeronautics Directorate's budget, largely because of the expenses involved in the operation and maintenance of NASA's 31 wind tunnels.

This is not the case for other portions of NASA, for which grants and contracts account for much of the cost. As a result, while the Aeronautics Directorate receives only 6 percent of NASA's total budget, it employs employs 23 percent of the entire NASA workforce and is responsible for 40 percent of all of NASA's infrastructure costs.

The Aeronautics Directorate comprises three programs – the Vehicle Systems Program; the Aviation Safety and Security Program; and the Airspace Systems Program. The Administration's proposed budget for the next five years for these three programmatic areas is shown below:

FY06 NASA Aeronautics Funding Request ($=millions)

	FY04 Actual	FY05 Actual	FY06 Request	FY07 Runout	FY08 Runout	FY09 Runout	FY10 Runout
Vehicle Systems Program	641.4	568.6	459.1	373.6	385.5	373.5	365.6
Airspace Systems	232.3	152.2	200.3	180.5	174.6	177.9	175.7
Aviation Safety and Security	183.1	185.4	192.9	173.5	170.5	176.2	176.3
TOTAL	**$1,056.8**	**$906.2**	**$852.3**	**$727.6**	**$730.6**	**$727.6**	**$717.6**

Vehicle Systems

Vehicle Systems emphasizes research in traditional air vehicle design concepts (examples being wing designs and high-speed aircraft), and for FY06, takes the biggest cut among the three programs (down $109 million compared to FY05, a 19 percent reduction). The proposed budget would make further reductions in the program in FY07, resulting in a cut of 33 percent (compared to FY05).

The cuts would be made by narrowing the program's focus beginning in FY06. The program would concentrate on projects designed to make significant leaps forward on technology and less on incremental changes. Specifically, the program would focus on four areas: (1) zero emissions aircraft – to demonstrate an aircraft powered by fuel cells; (2) subsonic noise reduction – to demonstrate a 50 percent reduction in noise compared to 1997 state of the art; (3) high altitude long endurance (HALE) – to demonstrate a 14-day duration high altitude, remotely operated aircraft; and (4) sonic boom reduction – to demonstrate technology that could enable acceptable sonic boom levels.

Research activities proposed for termination in the FY06 Vehicle Systems program include hypersonics (higher-speed aircraft), rotorcraft (helicopters), and improvements in engine efficiency.

To conduct its research, Vehicle Systems relies heavily on wind tunnels and propulsion test facilities. The proposed budget appears to assume the closure of one or more of these

facilities with associated cutbacks in staff (see below). However, NASA has not released any information on which facilities it would close or when, or the criteria on which closure decisions would be based.

In arguing for the proposed changes in the Vehicle Systems Program, NASA has cited a 2004 National Academy of Sciences report, "Review of NASA's Aerospace Technology Enterprise: An Assessment of NASA's Aeronautics Technology Program," led by Dr. John Klineberg. The report did recommend that NASA reduce the number of research projects it conducted, stating, "NASA is trying to do too much within the available budget and resists eliminating programs in the face of budget reductions." It also concluded that NASA's "aeronautics technology infrastructure exceeds its current needs, and the agency should continue to dispose of underutilized assets and facilities." But while the Academy report listed individual projects it thought were a low priority, it did not recommend the elimination of whole categories of research as NASA has proposed. The report also did not elaborate on its recommendation concerning underutilized facilities. (A summary of the report is attached.)

Airspace Systems

Airspace Systems supports research to improve air traffic management. In conjunction with FAA, NASA is supporting the Joint Planning and Development Office, which is overseeing the effort to develop a next-generation air traffic management system. The Airspace Systems program would receive the largest increase of the programs within NASA's aeronautics portfolio in the FY06 budget, increasing by $48 million or about 32 percent. However, the program would still receive less than it did in FY04, and it would receive less in subsequent years. The increase in FY06 would be used to provide more funds for a number of software development projects, whose budgets would remain flat after that. A number of current projects would be completed during the out-years, resulting in the drop in overall funding for the program.

Aviation Safety and Security

The Aviation Safety and Security program conducts research to prevent the most common types of fatal accidents in aviation, such as planes colliding with mountainous terrain or other obstacles on the ground, and eliminating intrusions by other aircraft onto active runways. It also seeks to develop concepts and technologies to reduce the vulnerability of aircraft and the National Airspace System to criminal and terrorist attacks while improving the efficiency of security. For FY06, NASA proposes to increase funding for this program by $7.5 million, or about 4 percent. The program would receive less funding in the out years.

Personnel

The proposed cuts in the aeronautics budget would be achieved, in part, by reducing the workforce. NASA has not specified what skills would no longer be needed because of programmatic changes or how the personnel cuts might be linked to facilities cuts. It is

unclear whether NASA decided how many employees would be cut based on budget targets, or whether the agency decided how many employees would no longer be needed for programmatic reasons and then calculated how much money would be saved as a result, or some combination.

Acting Administrator Fred Gregory testified on February 17 that no one at NASA would be laid off involuntarily before FY07, raising the question of what NASA would do if buyout offers did not result in the expected reductions.

NASA FY06 Budget Request
Proposed Aeronautics Workforce

	FY05	FY06	FY07	FY08	FY09	FY10	Delta FY10 vs. FY05
Dryden Flight Research Center, CA							
Civil Service	424	408	293	295	285	264	-160
Contractor Workforce	299	255	228	243	242	242	-57
Total Workforce	723	663	521	538	527	506	-217
Langley Research Center, VA							
Civil Service	1327	1004	764	690	647	604	-723
Contractor Workforce	990	594	743	563	506	450	-540
Total Workforce	2317	1598	1507	1253	1153	1054	-1263
Glenn Research Center, OH							
Civil Service	790	647	429	404	385	362	-428
Contractor Workforce	295	267	235	233	230	216	-79
Total Workforce	1085	914	664	637	615	578	-507
					Total Civil Service		-1311
					Total Contractor		-676
					Total Reduction		**-1987**

Issues

The Committee plans to explore the following issues at the hearing:

- **What would the impact of the proposed cuts be on American civil aviation?** This critical question is difficult to answer at this point because NASA has not made clear exactly what would be cut, particularly in terms of facilities and job categories.

  What is clear is that the cuts would come at a critical time for the U.S. aviation industry. The sole surviving American manufacturer of large civil aircraft, Boeing, is facing ever stiffer competition from its European competitor, Airbus. The two U.S. turbine engine manufacturers, General Electric and Pratt and Whitney, also face tough competition. It is not clear what kind of research would be most helpful to U.S. industry and to U.S. aviation generally. Clearly, the air traffic control and environmental issues on which NASA intends to focus would be at the top of any research priority list.

  In terms of vehicle systems research, NASA is looking at eliminating incremental research, but this is the research that companies are likely to be most interested in as

they can quickly adopt its results. But some experts argue that industry should pay for shorter-term research on its own.

One example of shorter-term research that NASA is backing out of is rotorcraft research. This concerns helicopter manufacturers who argue that helicopters are still an "immature technology" for which many improvements are possible and that foreign competition is increasing.

But NASA has had a mixed record with the kind of far-ranging research it proposes to focus on. In the past, it has discontinued many revolutionary technology programs before they were completed. For example, in the FY06 budget, NASA proposes to end work on hypersonics (which included a high-profile test late last year of the X-43A scramjet, which set a new record for speed).

One reason for the uncertainty about what approach NASA should take is that NASA has no overarching plan for aeronautics, in contrast to the way the President's Exploration Vision is setting the agenda for the exploration programs and the way that National Academy of Sciences priority-setting exercises guide NASA's science programs. NASA is in the process of funding several efforts to develop an aeronautics agenda. This month, a study funded by the National Institute of Aeronautics, a university consortium, is due to make recommendations. This summer, an internal NASA "roadmapping" exercise (which includes outside advisory committees) is scheduled to lay out a plan for aeronautics. And in late 2006, the National Academy of Sciences is expected to complete a "decadal survey" for aeronautics (based on similar surveys done in space science) that would lay out a consensus on priorities in aeronautics over the next ten years.

- **What would be the impact of NASA closing wind tunnels?** NASA currently operates 31 wind tunnels, with widely varying utilization rates. Wind tunnels are very expensive to build and operate, and their designs are carefully tailored to achieve precise flow conditions within a narrow range of speed and altitude. No single wind tunnel is suitable for replicating all flight conditions (e.g., high and fast as well as low and slow). Throughout the world, most wind tunnels are supported by governments. Over the past two decades NASA has reduced its number of wind tunnels and propulsion test facilities by one-third.

  NASA commissioned a study last year from RAND, which concluded that NASA should continue to operate 29 of its 31 wind tunnels. RAND estimated the annual operating cost of all 31 tunnels to be $125-$130 million. RAND argued that while some of the tunnels were not well used now, they offered capabilities that could be needed in the future and that would be hard to replicate if the tunnels were shut down. RAND also argued that while some questions that once needed to be solved with wind tunnels could now be answered through computer simulation, many critical questions still required wind tunnels. It also said that wind tunnel data were sometimes needed to develop computer simulation software.

In addition to NASA itself, industry and the Department of Defense use NASA wind tunnels. NASA has increased the fees it charges industry to use its wind tunnels, now basing charges on the full cost of maintaining a wind tunnel rather than on the incremental cost of the specific work being done. Because of increased fees and because of the age and limitations of some of NASA's facilities, U.S. companies are more frequently using foreign wind tunnels. This has raised issues about whether the U.S. should be wary of becoming dependent on foreign facilities as well as concerns about whether trade secrets may be lost in using foreign tunnels.

Background

NASA's Aeronautics Research

Virtually every airplane flying today employs technological innovations developed by NASA. Examples include the high-bypass turbine engine that provides much greater fuel efficiency and lower noise emissions than original 1960's-era jet engines; "fly-by-wire" control systems that use computers and wires instead of heavy, maintenance-intensive hydraulics systems to control an airplane's rudder and wing flaps; flight management systems such as the "black boxes" that continuously monitor an aircraft's engines, speed, location, and other critical parameters; and advanced composites made out of materials such as graphite and epoxy that can be used to replace heavier and more maintenance-intensive aluminum alloy structures. The Boeing 787, now under development, will be the first large civil aircraft to use composite materials in its fuselage.

The U.S. Aircraft Industry

The domestic aeronautics industry has changed substantially over the last ten to fifteen years through consolidations. Today there is only one manufacturer of large civil aircraft, Boeing, and just two turbine engine manufacturers for large civil aircraft, General Electric and Pratt & Whitney. The U.S. has no domestic regional jet manufacturers, the fastest growing segment in civil aviation; most are made in Canada and Brazil. The business jet and general aviation aircraft industry has a much larger number of producers.

Boeing is this country's largest exporter of manufactured products (based on dollar value), and there are thousands of suppliers whose products are found in each jet. Airbus,[1] a European company and Boeing's only rival, has overtaken Boeing in terms of winning new aircraft orders. Parenthetically, earlier this year Airbus unveiled its new A380 aircraft, a "super jumbo" that will be the world's largest passenger-carrying aircraft (it can seat over 800 in a single-class layout). The A380's first flight is scheduled for later this spring.

[1] Airbus began over 30 years ago as a government-created and owned entity with direct investment by the British, French, Spanish, and German governments. It has since been spun off as a private company owned by EADS and BAE systems, both European based conglomerates.

Earlier this decade, the European Union (EU) identified aeronautics as part of a continent-wide industrial strategy. The EU produced a research program document, "Aeronautics 2020," that explicitly states its objective of becoming the world's leading supplier of aeronautics goods and services and achieving parity with Boeing. Arguably, it has met its goal. The EU also has set a goal of taking a leadership role in developing the design and production of next generation air traffic management services.

Witness Questions

In their letters of invitation, the witnesses were asked to address the following questions:

Dr. Vic Lebacqz, NASA –

Please briefly describe NASA's long-term national aeronautics strategy and goals of the Aeronautics Research Mission Directorate with particular emphasis on the following questions—

- How do the funding and programmatic changes in NASA's FY 2006 budget proposal affect the Aeronautics Mission Directorate's ability to achieve its goals?
- Which wind tunnels is NASA planning to close and when is it planning to close them? What criteria were used to select those tunnels? What effect will the agency's decision to close wind tunnels and propulsion test facilities have on the ability of the Mission Directorate to meet its goals? How will NASA ensure that its workforce retains the skills that are critical to the agency achieving its long term goals?

Dr. John Klineberg, National Academy of Sciences –

Please briefly describe the findings and recommendations of the National Research Council's review of NASA's aeronautics technology programs with particular emphasis on the following questions—

- Over the next two decades, what are the main challenges facing the aeronautics industry and our aviation infrastructure? What are the Nation's most pressing strategic needs in civil aeronautics?
- What role do NASA's aeronautics programs and strategic plans have in fulfilling the Nation's strategic needs in civil aeronautics? How effective are NASA's programs in helping to ensure U.S. industrial competitiveness in civil aeronautics markets worldwide?
- What effect do you believe NASA's proposed budget (including proposed changes in funding, workforce, and operation of wind tunnels) will have on its ability to meet the nation's strategic needs in civil aeronautics?
- What steps, if any, do you recommend NASA take to better meet the Nation's needs?

Dr. Philip Anton, RAND –

Briefly describe the findings and recommendations contained in your study and analysis of NASA's inventory of wind tunnels and propulsion facilities with particular emphasis on the following questions—

- What would be the consequence to American aviation of NASA closing one or more wind tunnels? Are there particular wind tunnels that it would be especially detrimental to close?
- Are there ways NASA could seek outside funding for its wind tunnels? Are there ways NASA could change its accounting practices regarding its wind tunnels?
- What are the disadvantages of relying on foreign wind tunnels and how serious are they?

Dr. John Hansman, MIT, and Dr. Mike Benzakein, Ohio State –

- Over the next two decades, what are the main challenges facing the aeronautics industry and our aviation infrastructure? What are the Nation's most pressing strategic needs in civil aeronautics?
- What role do NASA's aeronautics programs and strategic plans have in fulfilling the Nation's strategic needs in civil aeronautics? How effective are NASA's programs in helping to ensure U.S. industrial competitiveness in civil aeronautics markets worldwide?
- What effect do you believe NASA's proposed budget (including proposed changes in funding, workforce, and operation of wind tunnels) will have on its ability to meet the nation's strategic needs in civil aeronautics?
- What steps should the government take to better address the Nation's strategic civil aeronautics needs? If continued research has an important role to play, what should be its priorities? How do you recommend NASA balance investment in evolutionary research against revolutionary, high-risk, high-payoff research?

Attachment

An Assessment of NASA's Aeronautics Technology Programs
National Research Council (2004)

Excerpts from the Executive Summary

The National Research Council Committee and its three subordinate panels conducted an independent peer assessment of the Vehicle Systems Program (VSP), the Airspace Systems Program (ASP), and the Aviation safety Program (AvSP), the three elements of NASA's Aeronautics Technology Programs. NASA specifically asked the committee and panels to address four questions:

1. Is the array of activities about right?
2. Is there a good plan to carry out the program?
3. Is the program doing what it set out to do?
4. Is the entire effort connected to the users?

The Committee's simple answer to the four questions posed by NASA is that, in general, the Aeronautics Technology Programs are very good but could be greatly improved by following the committee's 12 top-level recommendations.

Top-Level Recommendations:

1. The government should continue to support air transportation, which is vital to the U.S. economy and the well-being of its citizens.
2. NASA should provide world leadership in aeronautics research and development.
3. NASA has many excellent technical personnel and facilities to achieve its aeronautics technology objectives but should improve its processes for program management.
4. NASA should eliminate arbitrary time constraints on program completion and schedule key milestones based on task complexity and technology maturity.
5. NASA should reduce the number of tasks in its aeronautics technology portfolio.
6. NASA should pursue more high-risk, high-payoff technologies.
7. NASA should reconstitute a long-term base research program, separate from the other aeronautics technology programs and projects.
8. NASA's aeronautics technology infrastructure exceeds its current needs, and the agency should continue to dispose of underutilized assets and facilities.
9. NASA should implement full-cost accounting in a way that avoids unintended consequences harmful to the long-term health of the aeronautics program.
10. NASA should develop a common understanding with the Federal Aviation Administration (FAA) of their respective roles and relationship.
11. NASA should seek better feedback from senior management in industry and other government organizations.
12. NASA should conduct research in selective areas relevant to rotorcraft.